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Report on fuel used in locomotives on the Boston and Maine Railroad.

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REPORT

ON

FUEL USED IN LOCOMOTIVES,

ON THE

Boston and Maine Railroad.

FOR

CHARLES MINOT, Esq.,

SUPERINTENDENT OF THE BOSTON AND MAINE RAILROAD,

AND

ROSS WINANS, Esq.,

LOCOMOTIVE ENGINE BUILDER, BALTIMORE, MD.

BOSTON:

STACY, RICHARDSON & CO., PRINTERS,

NO. 11 MILK STREET.

1850.

BOSTON, *April* 17, 1850.

WM. P. PARROTT, ESQ.:

Secretary N. E. Association of R. R. Superintendents: —

DEAR SIR, — In an accompanying package I send you a copy of a Report made to me by Messrs. Slade and Currier, Engineers, employed to test the relative economy of Wood and Anthracite Coal, which Report please place on the files of the Association.

Respectfully, Yours,

CHAS. MINOT,

Superintendent Boston and Maine Railroad.

New-England Association of Railroad Superintendents, fourth regular meeting, April 17, 1850.

Voted, That the Report presented by Mr. Minot be accepted by the Association, and printed for distribution among the members.

WM. P. PARROTT, *Sec'y.*

BOSTON, *March* 1, 1850.

Charles Minot and Ross Winans, Esquires: —

GENTLEMEN, — The annexed Report is submitted as the result of the investigations of the undersigned, Commissioners appointed to make experiments on the Boston and Maine Railroad, with a *new Locomotive*, (a Coal burning engine,) built by Ross Winans, of Baltimore, — and with the Locomotive "New-Hampshire," (a Wood burning engine,) built by Messrs. Hinckley & Drury, of Boston, Mass.

The experiments were made for the purpose of testing the relative values of Anthracite Coal and different kinds of Wood, for fuel in Locomotives; also for the purpose of testing the actual value of the Coal burning Locomotive.

Very Respectfully,

Your Obedient Servants,

JAMES SLADE, *C. E.*,
N. BYRON CURRIER, *C. E.*

INTRODUCTORY REMARKS.

January 22. First trip of the "COALER," from Boston. This trip is taken into account, although the day was very stormy. It rained and snowed, and there was a very strong head-wind. From Exeter to Dover there were about six inches of snow on the rails.

The calculations for this trip were ended at Dover, because the snow was so troublesome, and because the fire ran down so low that wood was used the rest of the trip.

January 29. The COALER left Boston with about four inches of snow on the rails, as far as Lawrence, but beyond this to Haverhill the track was clear, because another train had gone ahead. From Haverhill the Coaler took the snow-plough (which had been brought down by the Wood engine) back to Great Falls. Part of the way snow had blown into the track, which made it more difficult for the engine to proceed. This trip is taken into the account.

January 30. Trip of the Coaler from Great Falls.

This trip is taken into account, although snow had blown into the track a great part of the way from Great Falls to the Portsmouth and Concord Railroad crossing. At this crossing the train stopped to leave and take freight. At this place the rails were covered so much with snow and ice that the engine could not start itself until it was cleared away from under the wheels. This trip would have been more favorable to the Coaler had the rails been clear.

At the end of the second trip of the Coaler, IN, it was discovered that the springs in the forward ends of the pistons were loose, and that steam had escaped without aiding in drawing the loads. How long it had been so it is impossible to say, or how much was lost in this way we have no means of judging. These trips, however, are calculated in our sheets without any allowance having been made for this circumstance.

At the end of the third trip, IN, it was discovered that one of the pistons was loose on its rod. During one of the trips a stick got into one of the pumps, which prevented its being used for the remainder of that day. It was taken out at night.

These are all the cases in which the engine was out of repair, or out of order, (as far as we are aware,) during our experiments.

Occasionally, during the trips with the Coaler, the variable exhaust pipe was used, but as a general thing it was used only near the end of the trips, when the fire was getting low.

When the Coaler is fired up in the morning, Wood is used for kindling. From this kindling sparks are thrown when the engine starts, and when it is running the first few miles.

The screen over the smoke-pipe is made of pieces of hoop-iron $\frac{1}{12}$ inch thick and 1 inch wide, set up edgewise. There are seventy-two of them in each foot, and as the spaces between them are as nearly equal as can be, they are but $\frac{1}{12}$ inch apart, when in their proper places. A few of them are now so much bent as to open spaces three-eighths of an inch wide between them, allowing sparks or cinders nearly of this thickness to get out. If the engineman attends to his duty, and shuts the screen up at starting, no fire can get out, of size sufficient to set anything on fire, which is removed a distance of four or five cars from the tender. The fact was noticed particularly that the sparks which did come out of

the smoke-pipe, when Coal alone was in the furnace, were very small and very nearly all extinguished before they reached the ground. Their specific gravity is such, that they fall to the ground much sooner than sparks from Wood engines, consequently there is not so much danger of setting fire as from the Wood engines.

All the trips of the Coal engine are taken into the account, without regard to wind or weather.

January 29. The Wood engine came down from Great Falls with the snow-plough on, and with five or six inches of snow on the rails. This trip is not taken into account.

January 30. Trip of the Wood engine to Great Falls was not obtained, consequently could not be taken into account.

In one of the trips, UP, the "NEW-HAMPSHIRE" had gone as far as North Andover, and while waiting there for a train to pass, the conductor learnt that some cars had arrived in Lawrence since the train left. The Engine alone was then run back to get them. This running back of the engine was not taken into account of miles run, in making up the tables. All the freight and cars are taken into the account, also all the water evaporated, and fuel used.

All the Wood engine trips, except the above two, are taken into account. All the other trips with both engines were with wind, weather and rails, in about the same condition, and therefore the comparisons are about equal in these respects. At the depôts the engines did a great deal of shifting of cars from one track to another, which could not well be measured in miles, and as it was probably nearly equal with each engine, no account has been taken of it in the tables which have been made up. The water was usually warmed before being put into either tender; in this respect the engines were about equal.

As far as our comparisons have been carried, the results are invariably in favor of the Coaler.

Should the Coal engine be run only between Haverhill and Boston, there would be another advantage in favor of it, from the fact that the track is double the most of the way. Where the track is single the engine is obliged to wait for other trains, with a furnace full of coal, which will burn out, and which must be replenished at a cost proportionate to the time which it waits. This is not the case with the Wood engines, for in them the wood is suffered to burn down, and need be replenished but little, until the time when the expected train comes in sight. The Coaler lost some hours in waiting for other trains, and so also did the Wood engine. In these cases the Coaler did waste considerable fuel, whereas the Wood engine wasted but little.

The labors of the Commissioners have resulted in fully convincing them that Anthracite Coal used for fuel in Locomotives on Railroads, where heavy trains are run, is superior to Wood, in point of economy.

In expressing this opinion, based upon these experiments, they wish to be distinctly understood as not in any way disparaging the Locomotive "New-Hampshire," for they consider that a first-class Wood burning engine.

EXPLANATION OF THE COLUMNS ON THE COALER SHEET.

No. 1, is the date when the engine was run.

No. 2, is the number of the trip.

No. 3, is the direction in which the trains run.

No. 4, is the kind of coal used.

No. 5, is the quantity of coal used, in pounds.

No. 6, is the quantity of coal used, in tons. This is the total quantity of coal put into the furnace during each trip. At the end of each trip there was an amount of coal, ashes and cinders left, equivalent to about fourteen cubic feet; one-half of this being ashes and cinders, would reduce the quantity left to seven cubic feet. As this would weigh about fifty-four pounds to the cubic foot, we should have 378 lbs. left, equivalent to $\frac{1}{6}$ of a ton: this at $5.25 per ton is worth 87 cents.

In firing up, one foot of wood was always used, which cost say 56 cents. The coal left was certainly equivalent to this. We therefore offset the coal left, against the wood used for kindling. The area of the grate is $4\frac{3}{4}$ feet by $3\frac{1}{2}$ feet, and the stuff left, varied from 9 to 12 inches deep.

No. 7, is the price of coal per ton.

No. 8, is the cost of coal per trip.

No. 9, is the depth of the water used, as measured in the tender.

No. 10, is the number of gallons of water used. The method of ascertaining the quantity, was, first to measure the water taken from the elevated cistern near the passenger depôt, and put into the tender. This was liable to objection from the fact that the cistern was covered, which made it difficult to measure it correctly; we therefore concluded to

have it weighed, and the method then was, to have each tender cleaned out, put on to the scales in the freight-house, and weighed, then taken to the cistern and filled, and after that weighed again. This was done with both tenders, and Mr. Johnson weighed them both in our presence. As was expected, they varied somewhat from our measurements. These results are the ones which are used in our estimates. The quantity was then estimated at $8\frac{1}{3}$ lbs. to the gallon—this is the United States standard for the wine gallon, at its maximum density. The water, when weighed, was in each case very near its maximum density, and the variation so slight as not to be appreciated.

No. 11, is the cubic feet of water used. These amounts are arrived at by simply dividing the gallons of water used by the number of gallons, $7\frac{48}{100}$, in a cubic foot.

No. 12, is the pounds of coal required to evaporate one cubic foot of water. This is arrived at by simply dividing No. 5 by No. 11.

No. 13, is the actual cost of coal to evaporate 3500 gallons of water, in each trip. 3500 gallons were taken as the standard, because it was an even number, and very near an average day's work, and afforded an easy means of comparison with the Wood engines. We say as 3255 gallons (column 10) is to 3500 gallons so is \$10.13 (column 8) to \$10.89, and so on.

No. 14, is the tons in 2000 lbs. of cars, carried one mile.

Mr. Blake gave us the weight of cars, as follows: —

Average weight of short box cars -	6000 lbs.	—1 car	
" " " platform do.	5000 "	—1 "	
" " long platform do.	12000 "	—2 "	
" " " box do.	12600 "	—2 "	
Total weight, ...	35,600 "	—6 "	
The weight of each, ...	5933 "		

requiring only an addition of 67 pounds to make the weight of each car 6000 pounds.

Mr. Blake also said, that having weighed quite a number of them, he considered 6000 lbs. nearest to their true weight. Although we have the numbers of a majority of the cars used in the trips, we found it would be quite difficult, if not impossible, to have them weighed — as they were distributed all along the road. In looking over these weights we find that the long box cars weigh the most, and as our trains were made up principally of them, we also considered 6000 lbs. to be nearest to their true weight, and therefore used it in making up this estimate of cars.

No. 15, is the tons (in 2000 lbs.) of freight, carried one mile. This freight we took from the books in the freight-house. As their books were not arranged with reference to these experiments, it required a great deal of care to get it from them; but with the gentlemanly assistance received from Mr. Blake, and the clerks in his office, it is believed to be correct.

In connection with this, the question came up as to what part of the fuel and water, for the Wood and Coal engines, should be considered as freight, and it was decided that the whole of the amount carried and not used; also one-half of the amount used should be considered as freight.

No. 16, is the tons (in 2000 lbs.) of cars and freight, carried one mile.

No. 17, is the cost of fuel for carrying 15,000 tons one mile, as derived from the cost of fuel per trip. To arrive at this, we say, as 8428 tons (column 16) is to 15,000 tons, so is $9.82 (column 8) to $17.48, and so on through the column.

No. 18, is the per centage of the different loads carried, taking the largest as 1000. In making this comparison, we assumed the largest load to be represented by the number 1000, consequently the others would be proportionally less than this, which proportion would be as follows: — as 28,372 (column 16) is to 1000, so is 8428 (column 16) to 297, and

so on through the column. The reason for making this comparison is, that the loads of the engines not being alike, we could not very well compare the trips over the whole road together, and this seemed to be a method of comparison which would convey a very correct idea of the loads carried. The largest load drawn by either engine at any time, was January 31, by the Coal Engine, when going up Ward Hill. The train consisted of seventy-six cars, making with the freight a total weight of 433 tons. This was about all the engine could do; it went steadily and firmly up the hill without using any sand, and without any slipping, except at one point, where some track repairers had just taken off a hand-car, and had left some snow on the rails. The driving wheels did slip on this snow, three or four turns of the wheels, and that was all the slipping whilst going up the hill. The largest load drawn by the Wood Engine was February 1, when going up Ward Hill. The train consisted of sixty-one cars, making with the freight a total weight of 391 tons. This was all the engine could do, for in going up the hill, sand was used, and whilst the sand run freely upon the rails the wheels adherred firmly to them, but when the sand stopped, as it did some of the time, the wheels did slip, and so much as to make it very conclusive that the engine could not carry any more up the hill; therefore the relative capabilities of the two engines may be considered to be, as 433 tons (drawn by the Coaler) to 391 tons (drawn by the New-Hampshire,) or as 10 (the Coaler) is to 9 (the New-Hampshire.)

No. 19, is the running time of each trip.

No. 20, is the stopping time of each trip.

No. 21, is the total time of each trip.

N. B. — The weights of the engine and tender are not included in any of these calculations.

EXPLANATION OF THE COLUMNS ON THE WOOD ENGINE SHEET.

No. 1, is the date when the engine was run.

No. 2, is the number of the trip.

No. 3, is the direction in which trains run.

No. 4, is the kind of wood used.

No. 5, is the quantity of wood used, in cords and feet.

No. 6, is the price of wood actually used, per cord. These prices are such as were received from Mr. Minot.

No. 7, is the cost of wood actually used, per trip.

No. 8, is the depth of water in tender used, in inches.

No. 9, is the gallons of water used. See No. 10 of the explanations of the Coaler.

No. 10, is the cost of evaporating 3500 gallons of water, with the wood actually used. To arrive at these results, we say, as 3504, (column 9,) the gallons of water used in the trip, is to 3500 gallons, (column 10,) so is $12.94 (column 7) the cost of wood used in the trip, to $12.92, and so on through the column.

No. 11, is the average cost of the different kinds of wood required to evaporate 3500 gallons of water, with the wood actually used. These averages are made by adding together the costs of evaporating 3500 gallons with each kind of wood, and dividing by the number of trips with each kind.

No. 12, is the average quantities of the different kinds of wood used, (required to evaporate 3500 gallons of water,) in cords and hundredths. For this we divide the average cost in column 11 by the price in column 6.

No. 13, is the actual cost of evaporating 3500 gallons of water, had Station Wood been used in these particular trips, instead of the kinds which were used. The standard value of each kind of wood is taken from column of average costs to evaporate 3500 gallons of water. We say as $13.16, (column 11,) the average cost to evaporate 3500 gallons with spruce wood, is to $12.68, (see station wood sheet,) the average value of Station Wood when the trip is from Boston, so is $12.92 (column 10) the actual cost of evaporating 3500 gallons this trip, to $12.45, the actual cost if Station Wood had been used this trip. When the trip is to Boston the value of Station Wood must be taken at $12.44 instead of $12.68. (See station wood sheet.) We took the average cost to evaporate 3500 gallons as the first term of the proportion, instead of the actual cost, because we considered this to be the only just and fair rate for the evaporation of 3500 gallons. We assumed column 11 to be the standard or fair rate, for the reason that we could not determine which of the trips run was the nearest to the true sum, and therefore averaged them.

No. 14, is the tons (in 2000 lbs.) of cars, carried one mile. See No. 14 of Coaler explanations.

No. 15, is the tons (in 2000 lbs.) of freight carried one mile. In this freight the wood used as fuel is put at 3000 lbs. per cord for hard wood, and 2000 lbs. per cord for soft wood; (it was all dry;) that which was carried over the road as freight we put at 4000 lbs. for hard, and 3000 lbs. for soft, per cord. These are the rates at which Mr. Blake reckons them.

No. 16, is the tons in 2000 lbs. of cars and freight, carried one mile.

No. 17, is the actual cost of fuel for carrying 15,000 tons one mile, as derived from the cost of fuel per trip. To arrive at this, we say, as 9218 tons (column 16) is to 15,000 tons,

so is $12.94 (column 7) to $21.06, and so on through the column.

No. 18, is the actual cost of carrying 15,000 tons one mile, if Station Wood had been used instead of the particular kinds which were used. The standard value of each kind of wood is taken from the column (11) of average costs to evaporate 3500 gallons of water. We say, as $13.16 (column 11) the average cost of spruce wood, is to $21.06 (column 17) the actual cost of fuel for the trip, to carry 15,000 tons one mile, so is $12.68 the average value of Station Wood, when the trip is from Boston, (see station wood sheet) to $20.29, the actual cost of carrying 15,000 tons with Station Wood this tripand, so on through the column. When the trip is to Boston the value of Station Wood must be taken at $12.44. (See station wood sheet.)

No. 19, is the per centages of the different loads carried, taking the largest as 1000. We say, as 23,648, (column 16,) the largest number of tons carried, is to 1000, so is 9218 tons, (column 16,) carried January 23, to 389, the per centage of that trip, and so on through the trips. See No. 18 of the Coaler sheet for further explanations, and also for the Ward Hill remarks.

No. 20, is the running time of each trip.

No. 21, is the stopping time of each trip.

No. 22, is the total time of each trip.

N. B. — The weights of the engine and tender are not included in any of these calculations.

EXPLANATION OF THE STATION WOOD SHEET.

THIS contains the quantities and prices of wood, which, it is estimated, are usually taken by Engines on the road.

We received from Mr. Minot a sheet which contained the estimated amounts of the different kinds of wood required on the trips from Boston to Great Falls, and the return trip; also from Boston to Haverhill and back. For the trip from Boston, the quantities taken were estimated to be —

From Boston,	- - -	8 ft. Spruce wood
" Reading,	- - - -	8 ft. White Pine
" "	- - - -	3 ft. Pitch Pine
" Haverhill,	- - -	4 ft. White Pine
" "	- - -	2 ft. Hemlock
" Exeter,	- - - -	7 ft. Hemlock
Total quantity,	- - - - - -	27 feet.

For the trip from Great Falls to Boston, the quantities were estimated to be —

From Great Falls,	- - -	$4\frac{1}{2}$ ft. Hemlock wood
" "	- - -	$4\frac{1}{2}$ ft. White Pine
" Exeter,	- -	9 ft. Hemlock
" Haverhill,	- -	$2\frac{2}{8}$ ft. White Pine
" "	- -	$1\frac{1}{8}$ ft. Hemlock
" Reading,	- - -	$2\frac{1}{2}$ ft. White Pine
" "	- -	$2\frac{1}{2}$ ft. Pitch Pine
Total quantity, equal	. . .	27 feet.

In going from Boston to Haverhill and back, the quantities were estimated to be —

From Boston,	- - -	8 ft. Spruce wood
" Reading,	- - -	2½ ft. White Pine
" "	- - -	2½ ft. Pitch Pine
" Haverhill,	- - -	4⅓ ft. White Pine
" "	- - -	2⅓ ft. Hemlock
" Reading,	- - -	8 ft. White Pine
" "	- - -	8 ft. Pitch Pine
Total quantity,	. . . . .	26 feet.

We found it necessary to alter the quantities, to make them agree with our assumed standard of 3500 gallons for a day's work. The proportions were kept very nearly the same. In the trip to Great Falls a great proportion of the wood being Spruce, the amount is a trifle less than when given to us. In the trip from Great Falls there is a large proportion of poorer wood, and consequently it required a larger amount for the day's work. The trip from Boston to Haverhill and back, also required an increase of wood. The amounts required are shown on the Station Wood sheet.

EXPLANATIONS

OF THE EQUAL PER CENTAGE SHEETS, WITH COAL AND STATION WOOD; ALSO, WITH WATER.

THESE sheets enable us to make comparisons of the cost with the two engines, to do an equal amount of work, and to evaporate an equal amount of water.

The greater the load on each engine (provided it is not beyond its ability to draw it) the cheaper each ton will be hauled over the road.

To make these comparisons, we take equal per centages of the different amounts of work done, and of water evaporated by each engine.

The result to be derived from these comparisons is, that the engine which does this per centage of work at the least cost, will do any other per centage of work with the same proportional saving of cost.

REMARKS ON THE COALER SHEET.

THE trip which shows the greatest average speed, (Feb. 1,) gives an average of $16\frac{2}{10}$ miles per hour.

The trip which shows the least average speed, (Jan. 31, gives an average of $10\frac{84}{100}$ miles per hour.

The 10 trips give an average of $14\frac{8}{10}$ miles per hour.

Average cost of 9 trips, with Wood, for carrying 15000 tons 1 mile, when the trips are over the whole road,	$14.22
Average cost of 7 trips, with Coal, for carrying 15000 tons 1 mile, when the trips are over the whole road, - - - - - - - - -	$12.70
Difference in favor of the Coaler, - - -	$1.52
Deducting the cost of Firebox, which is one cent per mile, equal to 76 cts. per trip, and 25 cts. per ton, for loading Coal, equal to 54 cts. per trip. Total,	$1.30
Leaves still a difference in favor of the Coaler, of	$0.22
If the Coaler runs only to Haverhill, the additional saving in favor of it will be, per trip, equal to (See station wood sheet.)	$1.41

COALER SHEET

TABULAR STATEMENT OF THE WORK DONE IN THE TRANSPORTATION OF FREIGHT WITH THE LOCOMOTIVE ENGINE *COALER*, UPON THE BOSTON AND MAINE RAILROAD, BETWEEN BOSTON AND GREAT FALLS, A DISTANCE OF 74 MILES, ON THE EXPERIMENTAL TRIPS, MADE IN JANUARY AND FEBRUARY, 1850.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Date of Trip.	No. of do.	From or to Boston.	Kind of Coal used.	Coal used, in pounds.	Coal in Tons of 2240 pounds	Price per Ton of Coal.	Cost of Coal per Trip.	Depth of Water in Tender used in inches.	Gallons of Water used.	Cubic feet of Water used.	Pounds of Coal required to evaporate 1 cubic ft. of Water.	Actual Cost of Coal to Evaporate 3500 Gallons of Water in each trip.	Tons in 2000 lbs. of Cars carried 1 mile.	Tons in 2000 lbs. of Freight carried 1 mile.	Tons in 2000 lbs. of Cars and Freight carried 1 mile.
January 22	1	From	Anthracite.	4325	1.93	$5.25	$10.13	87 3-4	3255	435	9.98	$10.89		4881	
" 23	2	To	"	4466	1.99	"	10.45	73	2708	362	12.34	13.51		5131	
" 24	3	From	"	4188	1.87	"	9.82	89 1-4	3310	442	9.47	10.38	4683	3745	8428
" 25	4	To	"	5204	2.32	"	12.18	90	3338	446	11.67	12.77	7137	8235	15372
" 26	5	From	"	4600	2.05	"	10.76	86 1-2	3208	429	10.72	11.74	6507	4542	11049
" 28	6	To	"	4513	2.01	"	10.55	88	3264	436	10.35	11.31	7641	7567	15207
" 29	7	From	"	4942	2.20	"	11.55	99 3-8	3686	493	10.02	10.97	7248	5222	12470
" 30	8	To	"	4480	2.00	"	10.50	88 1-2	3282	439	10.20	11.19	7122	6033	13155
" 31	9	From	"	6529	2.92	"	16.45	152 1-8	5642	754	9.19	10.20	14463	13909	28372
" 31	9	From	Cumberland	404	0.18	6.25									
February 1	10	To	"	4208	1.88	"	11.75	92 1-4	3422	458	9.19	12.02	9252	7277	16529
Total of	10	Trips,	- -	47859	21.36			946 3-4	35115	-	103.18				
Average of	10	"	- -	4786	2.14			94 3-8	3512	-	10.31				
Total of	9	"	- -		19.47			- -	31693	-	93.94				
Average of	9	"	- -		2.16			- -	3521	-	10.44	$11.44			

Tabular Statement of the Work done by the COALER, *continued.*

1	2	3	17	18	19	20	21
Date of Trip.	No. of do.	From or to Boston.	Cost of Fuel for carrying 15000 tons 1 mile, as derived from Cost of Fuel per Trip.	Per centage of the different loads carried, taking the largest as 1000.	Running Time.	Stopping Time.	Total Time.
					H. M.	H. M.	H. M.
January 22	1	From			5.22	3.33	8.55
" 23	2	To			4.50	3.01	7.51
" 24	3	From	$17.48	297	5.09	4.28	9.37
" 25	4	To	11.88	542	5.07	4.11	9.18
" 26	5	From	14.61	389	5.18	3.38	8.56
" 28	6	To	10.40	536	4.54	3.29	8.23
" 29	7	From	13.90	439	5.23	4.44	10.07
" 30	8	To	11.97	463	4.35	2.58	7.33
" 31	9	From	8.69	1000	7.21	3.45	11.06
February 1	10	To	10.66	583	4.34	3.05	7.39

Total of 8 Trips,	-	$99.59
Average of 8 "	-	12.45
Total of 7 "	-	88.93
Average of 7 "	-	12.70

WOOD ENGINE SHEET.

TABULAR STATEMENT OF THE WORK DONE IN THE TRANSPORTATION OF FREIGHT, WITH THE LOCOMOTIVE ENGINE *NEW-HAMPSHIRE*, UPON THE BOSTON AND MAINE RAILROAD, BETWEEN BOSTON AND GREAT FALLS, A DISTANCE OF 74 MILES, ON THE EXPERIMENTAL TRIPS MADE IN JANUARY AND FEBRUARY, 1850.

1	2	3	4	5	6	7	8	9	10	11	12	13
Date of Trip.	No. of do.	From or to Boston.	Kind of Wood used.	Quantity of Wood used.	Price of Wood actually used, per cord.	Cost of Wood actually used per trip.	Depth of Water in Tender used, in inches.	Gallons of Water used.	Cost of Evaporating 3500 gallons of Water with Wood actually used.	Average cost of the different kinds of Wood to evaporate 3500 Gallons of Water with the Wood actually used.	Average quantity of the different kinds of Wood used, required to evaporate 3500 Gallons of Water.	Actual Cost of evaporating 3500 Galls. water, had Station Wood been used in these particular trips, instead of kinds which were used.
January 23	1	From	Spruce	2 Cords, 7 ft.	$4.50	$12.94	73	3504	$12.92	$13.16	2 Cords 92-100	$12.45
" 24	2	To	Hemlock	3 " 6 1-2 "	3.75	14.29	83 3-8	4002	12.50	12.75	3 " 40-100	12.20
" 25	3	From	Pitch Pine	3 " 1 "	3.75	11.72	66	3168	12.95	13.20	3 " 52-100	12.44
" 26	4	To	White Pine	3 " 4 1-4 "	3.00	10.59	63 3-4	3060	12.11	11.60	3 " 87-100	12.99
" 28	5	From	White Pine	3 " 6 1-2 "	3.00	11.44	75 1-4	3612	11.08	11.60	3 " 87-100	12.11
" 31	8	To	Pitch Pine	3 " 2 "	3.75	12.19	66	3168	13.46	13.20	3 " 52-100	12.68
February 1	9	From	Spruce	3 " 4 "	4.50	15.75	90 1-2	4344	12.69	13.16	2 " 92-100	12.23
" 2	10	To	Spruce	3 " 4 "	4.50	15.75	82 3-4	3972	13.87	13.16	2 " 92-100	13.11
" 4	11	From	Beech	2 " 7 1-2 "	4.75	13.96	99 1-4	4764	10.25	10.25	2 " 16-100	12.68
" 5	12	To	Peel'd Hem.	3 " 5 3-4 "	3.75	13.94	78	3744	13.00	12.75	3 " 40-100	12.69
Total of 10 Trips, - - - - -				34 " 0 1-2 "	- - - - -		777 7-8	37338				
Average of 10 " - - - - -				3 " 4-10 "	- - - - -			3734				
Total of 9 " excluding Beech,				31 " 12-100 "	- - - - -			32574				
Average of 9 " " "				3 " 46-100 "	- - - - -			3619				

Tabular Statement of the Work done by the Locomotive Engine NEW-HAMPSHIRE, *continued.*

1	2	3	4	14	15	16	17	18	19	20	21	22	
Date of Trip.	No. of do.	From or to Boston.	Kind of Wood used.	Tons in 2000 lbs. of Cars carried 1 Mile.	Tons in 2000 lbs. of Freight carried 1 Mile.	Tons in 2000 lbs. of Cars and Freight carried 1 mile.	Actual cost of fuel for carrying 15000 tons 1 mile, as derived from the cost of fuel per trip.	Actual cost of carrying 15000 tons 1 Mile, if Station Wood had been used instead of the particular kinds which were used.	Per centage of the different loads carried, taking the largest as 1000.	Running Time.	Stopping Time.	Total Time.	REMARKS.
										H. M.	H. M.	H. M.	
Jan. 23	1	From	Spruce	5649	3569	9218	$21.06	$20.29	389	4.47	6.24	11.11	The Trip which shows the greatest average speed, Jan. 23, gives an average of 15 89-100 miles per hour.
" 24	2	To	Hemlock	9930	8819	18749	11.43	11.15	793	5.08	3.02	8.10	
" 25	3	From	Pitch Pine	6915	5654	12569	13.99	13.44	531	5.23	3.09	8.32	
" 26	4	To	White Pine	7533	5805	13338	11.91	12.77	564	4.49	3.29	8.18	
" 28	5	From	White Pine	7407	3945	11352	15.11	16.51	480	5.37	4.55	10.32	The Trip which shows the least average speed, Feb. 4, gives an average of 12 9-100 miles per hour.
" 31	8	To	Pitch Pine	7704	3975	11679	15.66	14.76	494	5.10	3.58	9.08	
Feb. 1	9	From	Spruce	11388	12260	23648	9.99	9.62	1000	6.13	4.30	10.43	
" 2	10	To	Spruce	11094	8192	19286	12.25	11.58	816	5.18	3.15	8.33	
" 4	11	From	Beech	11265	11561	22826	9.17		965	6.17	3.30	9.47	The 10 trips give an average of 14 1-10 miles per hour.
" 5	12	To	Peel'd Hem.	8382	4195	12577	16.62	16.22	532	4.53	2.50	7.43	
Total of 10 Trips,						155242	$137.19						
Average of 10 "						15524	13.72						
Total of 9 " excluding Beech,						132416	128.02	$126.34					
Average of 9 "			"			14713	14.22	14.04					

WATER SHEET.

Comparison of the equal per centage Trips of the NEW-HAMPSHIRE *and the* COAL ENGINE, *showing the value of Station Wood and Coal to evaporate* 3500 *Gallons of Water. Trips, from Boston to Great Falls and back. The Cost of Station Wood is taken from the Column (13) of Cost of Station Wood to evaporate* 3500 *Gallons. The Cost of Coal is taken from Column (13) of Actual Cost to Evaporate* 3500 *Gallons.*

Jan. 24, per centage of Coaler, is 0 297, and is less than any of the Wood per centages, and cannot well be compared with them.

Jan. 23,	"	"	New-Hampshire,	0.389,	and	Cost of Evaporating 3500 Gallons,	$12.45	
Jan. 26,	"	"	Coaler,	0.389	"	"	11.74	Diff., $0.71
Jan. 28,	"	"	New-Hampshire,	0.480	"	"	$12.11	
Jan. 31,	"	"	"	0.494	"	"	12 68	
				2) 0.974	"	"	2) 24.79	
			Averages,	0.487	"	"	12.39	Average carried out, $12.39.
Jan. 29,	"	"	Coaler,	0.459	"	"	$10.97	
Jan. 30,	"	"	Coaler,	0.468	"	"	11.19	
				2) 0.902	"	"	2) 22.16	
			Averages,	0.451	"	"	11.08	Average carried out, $11.08. Diff., $1.31

Jan. 25, per centage of		New-Hampshire,	0.531,	and Cost of Evaporating 3500 Gallons,			$12.44		
Jan. 26, "	"	"	0.564	"	"	"	12.99		
Feb. 5, "	"	"	0.532	"	"	"	12.69		
			3) 1.627	"	"	"	3) 38.12		
		Averages,	0.542	"	"	"	12.71	Average carried out, $12.71.	
Jan. 25, "	"	Coaler,	0.542	"	"	"	$12.77		
Jan. 28, "	"	Coaler,	0.536	"	"	"	11.31		
			2) 1.078	"	"	"	2) 24.08		
		Averages,	0.539	"	"	"	12.04	Average carried out, $12.04.	Diff., $0.67
Jan. 24, "	"	New-Hampshire, 0.793, and nothing in Coaler to compare with this.							
Feb. 2, "	"	"	0.816	"	"	"	"		
Feb. 1, "	"	"	1.000	Cost of Evaporating 3500 Gallons,			$12.23		
Jan. 31, "	"	Coaler,	1.000	"	"	"	10.90		Diff., $2.03
									4) 4.72
								Final Average in favor of Coal,	- $1.18

REMARKS.—This final average is the amount which the Coal Engine evaporated water cheaper in each trip than the Wood Engine would have done, had it used Station Wood when the trips were over the whole road. But if the Coal Engine should be run from Boston to Haverhill only, then as the Wood to Haverhill costs $1.41 per trip more than the through trips for the same amount of work, (see station wood sheet,) this should be added to $1.18, making a difference of $2.59 in favor of the Coaler, in each day's work of the Haverhill trips.

FREIGHT SHEET.

Comparison of the equal per centage Trips of the NEW-HAMPSHIRE *and the* COAL ENGINE, *showing the Cost of Fuel to carry* 15,000 *Tons* 1 *mile. Trips, from Boston to Great Falls and back. The Cost of Wood is taken from the column* (18) *of Cost of Station Wood for carrying* 15,000 *Tons* 1 *mile.*

Jan. 24, per centage of Coaler, is 0.297 and is less than any of the Wood per centages, and cannot well be compared with them.

Jan. 23, " "	New-Hampshire,	0.389	Cost of carrying 15,000 Tons,			$20.29	
Jan. 26, " "	Coaler,	0.389	"	"	"	14.61	Difference, $5.68
Jan. 28, " "	New-Hampshire,	0.480	"	"	"	$16.51	
Jan. 31, " "	"	0.494	"	"	"	14.76	
		2) 0.974	"	"	"	2) 31.27	
	Averages,	0.487	"	"	"	15.63	Average carried out, $15.63.
Jan. 29, " "	Coaler,	0.439	"	"	"	$13.90	
Jan. 30, " "	"	0.463	"	"	"	11.97	
		2) 0.902	"	"	"	2) 25.87	
	Averages,	0.451	"	"	"	12.93	Average carried out, $12.93. Diff., $2.70

Jan. 25, per centage of New-Hampshire,	0.531	Cost of carrying 15,000 Tons,	$13.44			
Jan. 26, " " "	0.564	" " "	12.77			
Feb. 5, " " "	0.532	" " "	16.22			
	3) 1.627	" " "	3) 42.43			
Averages,	0.542	" " "	14.14	Average carried out, $14.14.		
Jan. 25, " " Coaler,	0.542	" " "	11.88			
Jan. 28, " " "	0.536	" " "	10.40			
	2) 1.078	" " "	.2) 22.28			
Averages,	0.539	" " "	11.14	Average carried out, $11.14.	Diff., $3.00	
Jan. 24, " " New-Hampshire,	0.793	Nothing in the Coaler to compare with this.				
Feb. 2, " " "	0.816	" " " " "				
Feb. 1, " " "	1.000	Cost of carrying 15,000 Tons,	$9.62			
Jan. 31, " " Coaler,	1.000	" " "	8.69		Diff., $0.93	
					4) 12.31	
				Final average in favor of Coaler,	$3.08	

REMARKS.—This final average is the amount which the Coal Engine carried 15000 tons 1 mile cheaper in each trip than the Wood Engine would have done had it used Station Wood, when the trips were over the whole road. If the Coal Engine should be run from Boston to Haverhill only, then, as the Wood to Haverhill costs $1.41 more per trip (see Station Wood Sheet) than the through trips for the same amount of work, this should then be added to $3.08, making a difference of $4.49 in favor of the Coaler, in each day's work of the Haverhill trips. If the column (17) of the actual Cost of Fuel had been used instead of the Station Wood column, (18,) the difference would have been 18 cents more per trip in favor of the Coaler.

STATION WOOD SHEET.

Quantities and Prices of Wood taken by the Engines on the Boston and Maine Railroad, on the Trips from and to Boston. The quantities are estimated to be the amounts usually taken at the different Wood Stations.

TRIP TO GREAT FALLS, WITH STATION WOOD.

From	Boston,	1.00	cord,	Spruce,	$4.50	—$4.50	Evaporates,	1200	Galls.
"	Reading,	0.36	"	W. Pine,	3.00	— 1.08	"	326	"
"	"	0.37	"	P. Pine,	3.75	— 1.39	"	368	"
"	Haverhill,	0.48	"	W. Pine,	3.00	— 1.44	"	434	"
"	"	0.26	"	Hemlock,	3.75	— 0.97	"	267	"
"	Exeter,	0.88	"	Hemlock,	3.75	— 3.30	"	905	"
		3.35	"	Woods, in value,		$12.68	"	3500	"

TRIP FROM GREAT FALLS, WITH STATION WOOD.

From	Great Falls,	0.61	cord,	Hemlock,	$3.75	—$2.29	Evaporates,	628	Galls.
"	"	0.58	"	W. Pine,	3.00	— 1.74	"	525	"
"	Exeter,	1.20	"	Hemlock,	3.75	— 4.50	"	1235	"
"	Haverhill,	0.33	"	W. Pine,	3.00	— 1.99	"	298	"
"	"	0.20	"	Hemlock,	3.75	— 0.75	"	206	"
"	Reading,	0.31	"	W. Pine,	3.00	— 0.93	"	280	"
"	"	0.33	"	P. Pine,	3.75	— 1.24	"	328	"
		3.56	"	Woods, in value,		$12.44	"	3500	"

3 35-100	Cords,	equal to	$12.68	
3 56-100	"	"	12.44	
6 91-100	"	"	$25.12,	therefore, 1 (average) cord, $3.63.

TRIP TO HAVERHILL AND RETURNING TO BOSTON, WITH STATION WOOD.

From Boston,	1.05	cords,	Spruce,	$4.50	—$4.72	Evaporates	1259	Galls.
" Reading,	0.33	"	W. Pine,	4.00	— 1.32	"	298	"
" "	0.34	"	P. Pine,	4.00	— 1.36	"	338	"
" Haverhill,	0.58	"	W. Pine,	3.75	— 2.17	"	525	"
" "	0.32	"	Hemlock,	3.75	— 1.20	"	321	"
" Reading,	0.38	"	W. Pine,	4.00	— 1.52	"	344	"
" "	0.42	"	P. Pine,	4.00	— 1.68	"	417	"
	3.42	"	Woods, in value,		$13.97	"	3502	"

$13.97

3.42 Cords, shows 1 Cord to be worth $4.08.

Trip to Haverhill and return, the Wood costs, $13.97.
The average of the Trips to Great Falls and back, 12.56.

Difference, $1.41 is the amount the Haverhill Trip costs more than the through Trips.

TRIP TO GREAT FALLS.

3 35-100 Cords of various Woods, (value, $12.68,) Evaporate 3500 Gallons.

TRIP FROM GREAT FALLS.

3 56-100 Cords of various Woods, (value, $12.44,) Evaporate 3500 Gallons.

TRIP TO HAVERHILL AND BACK TO BOSTON.

3 42-100 Cords of various Woods, (value, $13.97,) Evaporate 3502 Gallons.

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9 TRIPS FROM AND TO BOSTON (SEE COALER SHEET.)

2 16-100 Tons, principally Anthracite Coal, (value, $11.44,) Evaporate 3500 Gallons.

Cost of Evaporating 3500 Gallons (10) with the Wood Engine's largest load, - - - - - - - -		$12.69
Cost of Evaporating 3500 Gallons (13) with the Coaler's largest load, - - - - - - - - - -	$10.20	
Add to the Coaler, 25 cts. per ton—54 cts. and 1 cent per mile for burning out fire grates—76. Total, - -	$1.30	$11.50
Difference in favor of Coaler, equal, - - - - -		$1.19

FINAL RESULTS OF THE EXPERIMENTS ON THE COAL BURNING ENGINE AND THE WOOD BURNING ENGINE.

THE average quantity of Station Wood required to Evaporate 3500 Gallons, is 3 45-100 Cords.

The average quantity of Anthracite Coal required to Evaporate 3500 Gallons, is 2 15-100 Tons.

Showing that 215 Tons of Coal are equal to 345 Cords of Station Wood, or that 1 Ton of Coal is equal to 1 6-10 Cords of Station Wood, or that 5-8 Ton of Coal is equal to 1 Cord of Station Wood.

The average cost of Fuel for carrying 15000 Tons of Freight 1 mile, when the trips are over the entire road, are 7 trips of Coal (see column 17 of Coal Sheet) and 9 trips of Station Wood, (see wood sheet, column 18,) being all the comparable results.

Wood, - - -	$14.04
Coal, - - -	12.70
Difference in favor of Coal, - - -	$1.34
When the Engine runs between Boston and Haverhill, there is to be added for increased Cost of Wood, (see station wood sheet,) per day, - - - - - - - - -	$1.41
Making a difference per day, in favor of Coal, - - -	$2.75

When such of the Trips are compared as puts the respective Engines on a par, as regards Evaporation of Water, (see equal per centage Water Sheet,) the Average Cost of Evaporating 3500 Gallons, is with Wood, - - - $12.44

with Coal, - - - 11.26

Difference in favor of Coal, - - - - - - -	$1.18
Additional cost of Wood to run to Haverhill and back, -	1.41
Making the difference in favor of Coal per day, - -	$2.59

When such of the trips are compared as puts the respective Engines on a par, as regards size of load, (see equal per centage, Freight Sheet,) the average cost of carrying 15000 Tons of Freight 1 mile, is with Wood, - - -	$14.92
with Coal, - - -	11.84
Difference in favor of Coal, per day, is - - - -	$3.08
Additional cost of Wood to run to Haverhill and back, -	1.41
Making the difference in favor of Coal, per day,	$4.49

In arriving at the above results, the average cost of Station Wood, when the trips are over the entire road, is, per cord, $3.63.

Average cost of Wood, when the trips are from Boston to Haverhill and back, is, per Cord, $4.08.

Cost of Coal, per Ton, $5.25.

In miles, per hour, the average speed of the Coaler is	14 3-10
" " " " " " Wood is	14 1-10
Difference in favor of Coal,	0 2-10

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